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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION ON CUSTOMER LOCATION ISSUES

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SUMMARY

No cost model or LEC cost study will ever have the ability to exactly measure the cost of providing universal service. Consequently, it is important that the selected cost mechanism make the best possible use of the best available data and not create an artificial sense of accuracy or precision. This is especially true in the customer location context where some data sets cannot be disaggregated beyond the CBG level. Hence, AT&T and MCI demonstrate in Section I that the proposed BCPM approach of increasing granularity through an artificial grid cell approach is inferior to the proposed Hatfield method of creating clusters using actual customer geocoded data.

Section II expands on the Hatfield Model's constantly improving approach to customer location estimation. Hatfield 4.0 already vastly outpaces the BCPM by applying a clustering algorithm that can account for empty CBs, locate customers in towns or a variable number of population clusters, and determine the type of dwellings in which the customers live in a given CBG. Future Hatfield releases will employ geocoded data to more accurately account for customer location in two stages. The first involves estimating the number of clusters within a wire center service area, the size and location of those clusters, and the distance between customers in a cluster. This stage is a necessary and natural springboard for the next -- mapping individual customer locations to the specific cables that serve them. The BCPM's proponents appear not to even contemplate undertaking such a process. The forthcoming Hatfield release will incorporate the first stage to further improve its already accurate clustering algorithm while the Model's designers continue investigating the efficacy of strand mapping.

In Section III, AT&T and MCI demonstrate that embedded network loop lengths should not be used to verify a forward-looking cost model's cost estimates. An efficient basic telephone network may include loop lengths that are longer or shorter than those in the existing network. And to the extent that empirical verification plays any role in selecting a cost model, incumbent LECs should bear the burden of demonstrating why their numbers -- which they often cherry picked to highlight the greatest Hatfield discrepancies from historic investment or withheld altogether -- do not reflect inefficiencies or network capabilities unnecessary for universal service.

Section IV addresses the state members' concerns about the Hatfield Model's misassignment of CBGs to wire centers. Their examination focused on Hatfield 3.0, whereas Hatfield 4.0 almost always assigns a CBG to the wire center that actually provides that CBG's service. A few errors may still arise when the CBG is served by more than one wire center, but these should be obviated as the Hatfield Model transitions to an endogenous cluster-driven assignment.

In Section V, AT&T and MCI show that the Hatfield Model best accounts for a wire center's actual line count by using SIC codes to allow variation in the number of lines assigned per employee by business type, including special access lines, and normalizing line counts for non-ARMIS companies. Finally, AT&T and MCI show that arbitrarily limiting a model's closing factors to 10% appears not to be necessary to ensure accurate estimates of universal service costs.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Federal-State Joint Board on Universal Service Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)) CC Docket No. 96-45) CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION ON CUSTOMER LOCATION ISSUES

Pursuant to the Commission's Further Notice of Proposed Rulemaking,[1] AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their joint comments with respect to the designated issues concerning the selection of a forward-looking cost mechanism for use in determining the level of federal support for universal service in high cost areas. These comments address issues related to customer location as requested by the Commission in section III.C.1 of its FNPRM.

[1] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45, 97-160, Further Notice of Proposed Rulemaking (released July 18, 1997) ("FNPRM").

INTRODUCTORY STATEMENT

No cost mechanism -- model or study -- will ever have the capacity to calculate exactly the cost of providing universal service.[2] Most fundamentally, significant input data limitations produce cost model output limitations. A good cost model then is one that makes the most of available (and reliable) input data -- basing outputs on that data and not purporting to generate outputs for which there is no underlying input data. The customer location issues on which the Commission seeks comment in this proceeding provide useful instruction on this fundamental principle and demonstrate yet additional bases to prefer the Hatfield Model, which is data-driven and continues to evolve and improve as more granular data are used and better algorithms are developed that can draw more accurate conclusions from these best available data.

As demonstrated below, the Benchmark Cost Proxy Model ("BCPM") falls short on each of the issues identified by the Commission. Notably, the current BCPM standard abstracts from any population clustering characteristics, instead favoring a simplistic and also cost-maximizing uniform distribution assumption. By contrast, the Hatfield Model has long recognized that a universal service cost mechanism must account for realistic population characteristics. Hence, each recent generation of the Model -- and future generations as well -- includes improved customer location estimation algorithms. Despite the BCPM's attempt now to catch up to the

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[2] Incumbent LEC "studies" face at least as many obstacles as cost models. For example, they invariably involve a set of approximations, assumptions, and algorithms for translating a limited data sample into a total estimate. In addition these "studies" start from an embedded network and therefore their proponents should bear the additional burden of demonstrating that they have accurately transformed embedded costs into forward-looking costs. Also, incumbent LEC studies are based on a network that uses embedded technology to provide services that are outside the scope of universal service, and their studies may assign the costs of such deployment to universal service.

Hatfield Model in this regard, it appears that the unreleased "new" BCPM, which may use a combination of CB, CBG, and "road" data, will still lag behind the Hatfield Model in every aspect related to customer location. Thus, the Hatfield Model is the only cost mechanism that promises to satisfy the Commission's tentative conclusions in this area.

I. GEOGRAPHIC UNIT AND COST ESTIMATE OUTPUT DISAGGREGATION SHOULD NOT EXCEED INPUT DATA DISAGGREGATION.

AT&T and MCI agree that "the size of the serving areas over which cost is calculated is an important element of platform design," and that a cost model should estimate and report costs at the finest level of detail (i) at which input data are available, and (ii) that is technically practical. FNPRM ¶¶ 39-40. The importance of these two constraints, particularly the reality of data limitations, cannot be overemphasized. The goal is "accurate cost estimates," and, as the Commission recognizes, any effort to report "costs" using "excessively small geographic units" that ignore data limitations not only does not advance that goal, but "creates a false sense of precision because the input data is still not disaggregated at that level." Id. ¶ 39. Furthermore, excessive disaggregation may overestimate universal service costs. In an efficient telephone network -- and presumably existing networks as well -- distribution and feeder are designed to service customers in groups, capitalizing on any clustering that exists. Even when no clustering exists, an efficient provider will still extend cables used to serve many customers as far as possible before separating them into individual wire pairs. Excessive disaggregation, however, may make customers artificially appear as singularities or in pairs, when in fact they are actually located in clusters than can be served more cost effectively.

Both the Hatfield Model and BCPM currently report costs at the Census Block Group ("CBG") level. That approach has a number of important benefits. First, a CBG is a relatively small unit, reflecting only approximately 400 households. Second, a wealth of relevant data are available disaggregated to the CBG level. And third, CBGs are not mere arbitrary constructs. Census Bureau census block ("CB") and CBG classifications and boundaries reflect to a certain degree natural geographic features and population clusters, and estimating and reporting costs at this level should therefore produce fewer "wide disparities in the cost of serving different customers in the same service area" (FNPRM ¶ 39) as compared to more arbitrary constructs such as grid cells. In short, CBs and CBGs may not be perfect geographic classifications, but they do reflect factors that have implications for engineering and telephony and are supported by the necessary input data.[3] A grid approach does not necessarily do so.

Below their CBG surfaces, however, the Hatfield Model and the BCPM are vastly different in their treatment of customer location. The Hatfield Model which in the past has used the most highly disaggregated data available, continues to follow a data-driven approach. Where insufficient data exists to justify moving to a smaller geographic unit per se, the Hatfield Model uses the data that are available to refine cost estimates at the CBG level. For example, as detailed below, Hatfield 4.0 adjusts cost estimates in rural CBGs with relatively large geographic areas with a population clustering mechanism that accounts for the empty space within each CBG. See FNPRM ¶ 42; infra at Section II (discussing both the current Hatfield algorithm and improvements that will be added). The Hatfield Model developers and sponsors continue to

[3] It appears that the new BCPM's grid cells will either exceed CBs in size or fall short. In any even, the information contained in CB or CBG boundaries will be jettisoned through the adoption of grid cells.

search for more disaggregated data that justify use of a smaller geographic unit (or further refinements at the CBG level).

By contrast, the BCPM developers appear to be following a process that models customer location under the false premise that increasing granularity is the same thing as enhancing accuracy. Specifically, the new BCPM will use an artificial grid cell approach that ignores that reducing geographical unit size is only useful to the extent that the corresponding input data can be further disaggregated.[4] Unfortunately, below the CB level data limitations frequently prohibit such disaggregation, forcing any cost model or study to ascribe many or all of the characteristics of the entire CB to the smaller geographic unit. But without good data to support this assumption, breaking the CB down into finer components adds nothing to a cost model's accuracy.[5] Thus, an algorithm employing an artificial grid will likely increase the complexity of the model without increasing its accuracy.

II. THE SELECTED COST MECHANISM SHOULD USE A CLUSTERING ALGORITHM.

AT&T and MCI agree that an <u>accurate</u> population clustering algorithm "would more accurately distribute customers within some CBGs and would consequently generate more

[4] AT&T and MCI have only had a viewgraph preview of the BCPM's future customer location algorithm. While the algorithm appears to incorporate some advances over the previous BCPM algorithm, it also has some very troubling aspects. In any event, it is impossible to meaningfully evaluate the new algorithm without a more thorough understanding of its logic. AT&T and MCI, then, will limit their comments to the current version of the BCPM and reserve the right to make further comments on the new model's customer location algorithm when it becomes available in operational form and with actual (not illustrative) data.

[5] While the new BCPM apparently will use road mileage within grids as an allocator for CB-level data, this methodology has not been specified completely, nor has it usefulness been verified.

accurate estimates of loop length and, therefore, of the cost of the outside plant" (FNPRM ¶ 44). In contrast to extreme presumptions underlying the current version of the BCPM, customers rarely are uniformly distributed within a CBG.[6] Instead, populations tend to form clusters, a characteristic that can significantly affect the amount of cable required to serve residential and business customers. See FNPRM ¶ 44. The Hatfield Model's developers have approached the issues of customer location and clustering in a series of progressive steps, with each additional level of complexity accepted only if it also increases the model's accuracy. First, the current version of the Hatfield Model and those predating it employ standard assumptions about population distributions to create customer clusters. Second, the next Hatfield release will use residence and business geocoded data to determine the number of clusters in a CBG, the size and location of those clusters, and the distance between customers within a cluster. This step is necessary for the third potential innovation, mapping individual cable strands to each customer location. As discussed below, strand mapping may ultimately prove unnecessary for accurate universal service cost estimation, but Hatfield's designers intend to investigate both the feasibility and desirability of adding this feature to their model. By contrast, the BCPM proponents -- by indicating that they will use block rather than point data -- are not proposing to develop a model that could incorporate strand mapping.[7]

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[6] See also FNPRM ¶ 41 ("Several commenters criticized the assumption, present in BCPM, that households are evenly distributed across a geographic unit. . . . At the proxy model workshops, a panelist provided several examples of specific locations where the uniform distribution assumption would cause significant errors. In addition, the panelist concluded that similar distortions exist in large regions of the country, and therefore, the uniform distribution assumption causes the model to overstate costs for many states").

[7] The proposed version of the BCPM will still rely on census block data that does not contain information regarding where customer lines are located relative to one another. The Hatfield (continued...)

Clearly, the Hatfield Model's proponents have been the leaders in developing better methods for modeling accurately the network costs that are sensitive to customer location. In response to the feedback received from the Commission and other industry participants, the Hatfield Model developers have already refined the customer location algorithm to better reflect actual population distributions within a CBG. For example, the area associated with CBs that do not have any population is removed so that networks are not engineered to serve empty space. See FNPRM ¶ 42. Indeed, as more refined data on customer clustering become available, they can be incorporated directly into the current version of the Hatfield Model because its degree of clustering is a user-adjustable parameter. Hatfield Model 4.0 Description at 27. Hatfield also applies standard assumptions about population distributions, placing large percentages of customers in either 2 or 4 "town" clusters depending on the amount of empty space in the CBG. See FNPRM ¶ 42; Hatfield Model 4.0 Description at 26. Further, Hatfield assigns customers to multi-unit dwellings and even high-rise buildings when census data and or high line density indicate that single-unit dwellings would be inadequate. See FNPRM ¶ 42; Hatfield Model 4.0 Description at 32-34.[8] The result has been a significant improvement in the accurate modeling of customer location.

AT&T and MCI, like the Commission, hope to go even further. See FNPRM ¶¶ 44, 46 (seeking comment on the availability of software capable of identifying customer locations "in all

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(...continued)
approach, on the other hand, will use geocoded data that allows the Model to determine the distances between customers and potentially to map individual cable strands to each customer location -- a technique that is impossible when relying on the BCPM's block data.

[8] This method -- unlike the BCPM -- preserves the overall size of the CBG and does not assume that all population is located in the center of the CBG.

CBs within a service territory" or of "geocod[ing] households").[9] Indeed, future releases of the Hatfield Model will incorporate geocoded data that locates exactly most customers. Such data can be used in two ways. Initially, geocoded data will provide important information on cluster characteristics, namely the number of clusters within a wire center service area, their geographic location, the size of the clusters, and distance between customers within the clusters.

Use of geocode data to determine cluster characteristics also provides a natural springboard for the second use of this data, mapping cable strands to each individual customer location. Translating actual customer locations into the individual cable strands that serve them is a difficult, but longer-term goal focus of the Hatfield Model necessitating not only much greater complexity and processor intensity, but also substantial revisions to other engineering aspects of a cost model. The Hatfield Model's developers are continuing to explore the feasibility and desirability of this approach. Whether or not actual strand mapping proves feasible and desirable, it is important to recognize, that accurately locating customers produces the greatest benefits (in accuracy) in sparsely populated areas. Consequently, the next release of Hatfield takes the necessary, but more tractable step of using these geocoded data to determine both the number of clusters in a wire center service area and their size and placement as well as to approximate the distance among customers within a cluster, instead of modeling a strand to each consumer. Early tests suggest that this method will be an excellent proxy for actual customer locations in the calculation of forward-looking costs, possibly accurate enough to render the complex modeling of

[9] Geocoding refers to the process of identifying each customer by latitude and longitude. Although geocoding is no panacea -- for example, in some areas postal addresses are predominantly post office boxes -- these data, where available for a particular geography, can be used to improve the accuracy of locating customers.

a cable strand to each customer superfluous (particularly given the tremendous increase in complexity that would accompany a strand mapping approach).

Finally, as the Commission recognizes, FNPRM ¶ 44, it is important to distinguish between the accuracy of (i) cluster location relative to wire center, which drives feeder costs, and (ii) how customers are located within a cluster, which drives distribution costs. Feeder constitutes a relatively small part of universal service costs because each feeder route is just one cable, with one set of supporting structures. Moreover, any cost estimation error should be small in densely populated areas because the feeder cable is very short. Even for more rural areas, the improvement in accuracy gained by more precisely specifying customer locations may be modes, as placing feeder routes to terminate at CBG centroids already is likely to be a good approximation to optimal feeder placement. The more variable, and more important factor is how customers are clustered within a distribution area. If customers are tightly clustered, a relatively small amount of distribution plant is required, while uniform dispersion of customer locations over a large geographic area will require many more distribution cables of smaller size. The most important step in modeling customer location, therefore, is to develop an effective clustering algorithm. Hatfield is vastly superior to the BCPM in both respects. Further, the Hatfield Model not only does a much better job of locating customers, it continues to improve as new data become available and innovative methods are developed to utilize that data. Hatfield's evolutionary process will continue so long as the gains in accuracy outweigh the costs in complexity.

III. EMBEDDED NETWORK DATA CANNOT BE USED TO "VERIFY" LOOP LENGTHS.

The Commission seeks comment on whether it should look to embedded incumbent LEC data to "verify" the accuracy of the cost models' estimates of loop lengths. FNPRM ¶¶ 44-45. While such data might be instructive on a very broad range scale, they cannot clearly verify loop lengths. Such comparisons are inconsistent with the core principles of the Commission's TELRIC methodology in that variance from figures that reflect past incumbent LEC practices cannot prove or disprove the accuracy or inaccuracy of forward-looking cost estimates.

While the Commission's scorched node approach defines points of concentration from which to design an efficient forward-looking telephone network, loop lengths may not remain the same as in the embedded network. For example, increased reliance on efficient "double star" DLC network architectures may increase loop lengths in some instances as backhauls become more economical. Similarly, an existing local switch may not support Centrex, prompting the incumbent LEC to instead route some customers over much longer loops to a distant switch that does have Centrex capabilities -- but this cost should not be supported by universal service subsidies. Further, the existing network may include inefficient loop configurations that might have been to an incumbent LEC's advantage under a rate-of-return regulatory regime, but would not be desirable or profitable in a competitive environment. An efficiently designed basic telephone network, therefore, may produce loop lengths that differ (both longer and shorter) from those in the existing network.[10] For these reasons, a closer correlation between a proxy model's

[10] It would, however, be appropriate to validate approximated customer locations by comparing them with actual locations because customer location is not a product of historic plant investment. Indeed, customer location is the one feature of the existing network that unequivocally must remain the same regardless of the forward-looking mechanism employed, even scorched earth.

outputs and embedded loop lengths does not mean that that model is doing a better job of estimating universal service costs than another model.

Moreover, to the extent that embedded empirical evidence plays any role at all in the "verification" process, the burden plainly should be placed on the incumbent LECs to explain the derivation and source of their embedded numbers, and why these numbers might differ from efficient cost model calculations. In general, these companies have not been forthcoming with data that lies exclusively in their possession, and their "verification" criticisms are usually based on a cherry picking of Hatfield Model results that have the greatest discrepancy from historic investment.[11]

IV. THE HATFIELD MODEL CURRENTLY ASSIGNS A CBG TO THE SAME WIRE CENTER THAT ACTUALLY SERVES THAT CBG IN MOST INSTANCES AND WILL DO SO EVEN MORE ACCURATELY IN FUTURE RELEASES.

Cost modeling must address two potential sources of line count error. The first arises when the cost model assigns a CBG to the wrong wire center. Concerns about Hatfield's "assignment of CBGs to incorrect wire centers" (FNPRM ¶ 49), however, are misplaced. The cited state members' comments were based on their evaluation of Hatfield 3.0. Hatfield 4.0 is much more effective in assigning a CBG to the same wire center that actually provides it service in the existing network. Indeed, Hatfield's approach already uses the best available assignment method and the Model's designers continue to make improvements. They are currently implementing a new assignment algorithm that will further reduce any error by utilizing a

[11] It appears that some of the incumbent LECs have responded positively to the Commission's data request (Universal Service Data Request in CC Docket 96-45, August 15, 1997) and have provided data that may prove useful. Others have chosen not to be so helpful in this process.

methodology that assigns an individual customer (not a CB or CBG) to a wire center based on the customer's actual telephone number when available -- not an arbitrary grid system. In those few instances, if any, where the Model continues to produce the incorrect assignment, the Model's designers would welcome any input as to how this state-of-the-art assignment methodology could be improved.

V. THE HATFIELD MODEL ACCOUNTS WELL FOR A WIRE CENTER'S ACTUAL LINE COUNT.

The second potential source of line count error arises when the number of lines in a geography is not accurately calculated. Hatfield 4.0 also does the best job in this respect. For example, Hatfield's line count algorithm is vastly superior to the BCPM's method of calculating business lines. The Hatfield Model employs SIC codes to allow variation among business types and the number of lines per employee.[12] The BCPM, on the other hand, simplistically and incorrectly assumes that the ratio of business lines per employee is the same throughout the state.[13] In other words, a travel agency would be assumed to have the same number of lines per employee as a manufacturing plant. In addition, as the Majority State Member Report

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[12] The Commission expressly sought input on whether it "should assign business lines to geographic units by using commercially produced maps that give the coordinates of all businesses located in the U.S. along with their employment by standard industrial classification (SIC) code." FNPRM ¶ 53. AT&T and MCI agree that the selected cost mechanism should satisfy these criteria to the extent that the necessary data exists. Consequently, the current version of Hatfield already accounts for SIC codes, and the next version of Hatfield will incorporate business geocoded locations. Moreover, the Hatfield Model will utilize point data, while the BCPM will only rely on block data.

[13] This criticism is very ironic inasmuch as one of the BCPM's sponsors, U S WEST, harshly criticized earlier versions of the Hatfield Model because of this same model limitation. The BCPM sponsors have suggested that this is one of the models' current shortcomings that will be addressed in the BCPM's next release.

recognized, Hatfield "include[s] special access lines, but BCPM does not." FNPRM ¶ 51. Hatfield 4.0 has also made significant strides for small incumbent LECs -- it now normalizes line counts for non-ARMIS companies[14] -- and preliminary verification against Detailed Distribution Area Planning cable lengths indicates that Hatfield estimates ample cable to meet network requirements. In contrast, the BCPM appears to be substantially less accurate at estimating the necessary cable amounts.

Finally, AT&T and MCI question the state members' proposal that models should always "match within ten percent actual wire center line counts" (FNPRM ¶¶ 49, 53), even though the Hatfield Model generally does close within the 10 percent factor.[15] It is not clear what this requirement would accomplish. The Hatfield Model already includes a user adjustable line count normalization process to ensure that the cost estimate is for the actual number of lines served by a wire center -- if the incumbent LEC has made that information available.[16] A high closing factor used to perform this normalization does not indicate that costs have been affected. Possibly some state members are concerned that a wire center will be "missed" -- not assigned a CBG -- by the cost model and therefore a high closing factor indicates a line count error for which normalization will not correct the cost estimate. While a small number of wire centers may still be "missed," most usually fall into one of four categories: (i) de minimis in size; (ii) lacking any working lines;

[14] Hatfield 4.0 "[i]ncludes improved counts of lines served by certain small LECs based on data from USTA and RUS[.]" Hatfield 4.0 Model Description at 8.

[15] AT&T and MCI have no objection to providing closing factor results at a level of detail necessary for analysis.

[16] Normalization will be even more accurate in many areas now that a number of incumbent LECs have finally agreed to make their wire center line count information available.

(iii) so new that no customers have been identified as being served by that wire center; or (iv) do not actually constitute a public wire center. If it is shown that any "missed" wire centers are relevant to universal service cost calculations, the Hatfield Model will be modified to incorporate them.

In short, then, it is not clear that "[r]easonable estimates of lines at the wire center and study area level will allow [the Commission] to verify that the models' means of estimating line count leads to accurate results." FNPRM ¶ 53. Rather than establishing an arbitrary maximum closing factors with uncertain positive effects, the Commission should focus on obtaining line count data from those incumbent LECs who still refuse to provide this information and thereby ensure that the normalization routine in the selected cost model is as accurate as possible.

CONCLUSION

For the foregoing reasons, the Commission should adopt the evolving Hatfield Model approach to the customer location issues raised in the Notice.

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CERTIFICATE OF SERVICE

I, Scott M. Bohannon, do hereby certify that on this 2nd day of September, 1997, I caused a copy of the foregoing Comments of AT&T Corp. and MCI Telecommunications Corporation on Customer Location Issues to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

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